

NGV Fuel Tank Testing – Adapting Standards for New Technologies

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NGV TF/MOVE Program Review Meeting
October 16, 2014



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Four basic types of NGV fuel tank designs

Which design to use depends on need to reduce weight, fuel storage requirements and cost

All designs have equivalent level of safety, since all meet the requirements of the same standards

Design type can also determine how a tank may be handled and how it may be filled

Type 1 – All metal (aluminum or steel)

Type 2 – Metal liner reinforced with composite hoop wrap

Type 3 – Metal liner reinforced with composite full wrap

Type 4 – Plastic gas-tight liner reinforced with composite full wrap



Road conditions are a very severe environment for pressure vessels

- Pressure extremes (300 psi – 4,500 psi)
- Multiple fills (11,250 cycles for 15 year life)
- Temperature extremes (-40°F – 185°F)
- Road environment and cargo spillage
- Vibration
- Vehicle fire
- Collision

Standards require tests or specify installation requirements to address these service conditions

Limited to the life of the vehicle (10 – 25 years)

- Alternative is to overdesign so it lasts indefinitely

Leak-before-break requirement

- If a fuel tank stays in service beyond its design life, and experiences excessive fill cycles, it will only fail by leakage

Fire protection is provided by a thermally activated pressure relief device (PRD) on every fuel tank

NGV Fuel Tank Regulations/Standards

All NGV fuel tanks **MUST** meet the federal government's FMVSS 304 (49 CFR 571.304), *Compressed Natural Gas Fuel Container Integrity*

All NGV fuel tanks **SHOULD** meet ANSI/CSA NGV 2, *American National Standard for Natural Gas Vehicle Containers*

- CSA B51 – Part 2 for Canada
- ECE R110 for Europe
- ISO 11439 for most other countries

Linerless Designs

- Similar to Type 4

Conformable Designs

- Non-cylindrical shape
- Internal structural members
- Intestine shape

ANG Designs

- Lower pressure
- Thermal effects during fueling and operation

Design Independent Changes

- New fiber type may require stress ratio value to mitigate stress rupture
- New resin/liner type may require additional materials tests

Conformable Designs

- Address orientation issues for drop, bonfire and penetration tests
- Define production inspection requirements for new manufacturing techniques
- Define materials tests for joints

ANG Designs

- May require a new standard, e.g. similar to ISO 16111 – “Hydrogen absorbed in reversible metal hydride”
- New definitions:
 - Maximum developed pressure, rated charging pressure, etc.
 - Stress level at maximum developed pressure
 - Operating temperature range, service temperature range
- Define impact during operation test
- Define CNG cycling and strain measurement test
- Define test to simulate thermal loading during fueling/operation

Next Steps for the Design Teams



1. Understand vehicle service conditions and existing performance tests – get familiar with ANSI/CSA NGV 2 or ISO 16111
2. Reflect on unique design nuances
3. Design new performance tests to address unique features
4. Join CSA NGV 2 Technical Subcommittee (conformable design teams) or approach CSA to develop new standard (ANG design teams)

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